



Capstan for Winding Kite Line

Written By: Albert den Haan



TOOLS:

- [#2 phillips screwdriver \(1\)](#)
- [1/4" drill bit \(1\)](#)
- [5/64" drill bit \(1\)](#)
- [Center punch \(1\)](#)
- [Drill bit the same size as your dowel \(optional\) \(1\)](#)
- [Hacksaw \(1\)](#)
for cutting the tire off the wheel
- [Power drill, drill press, or Dremel \(1\)](#)
- [Scroll saw \(hand or electric\) \(1\)](#)
- [Wood saw to cut the dowel twice \(1\)](#)
- [metal vise \(1\)](#)
- [shop knife to cut the tubing \(1\)](#)



PARTS:

- [3/4" hardwood dowel \(3-4' long\) \(1\)](#)
larger diameter dowel will work too; it will be heavier
- [5/16" x 4" bolt \(1\)](#)
if a larger dowel is used, pick a longer bolt to match
- [eye bolt with wood screw thread 1/8" by 3/4" by 2" \(3\)](#)
- [1/8" Sintra \(or lite-ply\) \(8"x11"\)](#)
- [1" Foam rubber \(1\)](#)
enough to make adaptor disks to fit inside the halo line reel(s)
- [Halo winder \(1\)](#)
- [6" plastic lawn mower wheel \(1\)](#)
Pick a wheel with a solid plastic hub; no separate bearing.
- [1" I.D. shimming washers \(1\)](#)
- [5/16" x 1/5/16 Hitch pin \(1\)](#)
- [5/16" wing nut \(1\)](#)
- [5/16" hexagonal nut \(1\)](#)
- [5/15" I.D. x 1 1/2" O.D. Fender Washer \(1\)](#)
- [5/16" metal washer \(2\)](#)
- [10' length of 9/16" \(outside diameter\) x 5/16" \(inside diameter\) flexible vinyl tubing \(1\)](#)
- [Shoelace or bootlace, at least 18" long \(1\)](#)
- [Drawer pull \(2\)](#)

These form the crank handles

- A halo winder of kite string. (1)
At least 4" in diameter is recommended .
The important part is that the wheel rim
is smaller than the smallest winding
diameter. Be sure to secure the inside
end of the line to the halo!
- 5/16" drill bit 3/4" cotter pin (1)

SUMMARY

This hand-cranked capstan pulls down kites easily and quickly but is lightweight and small enough to be portable. A power option can be added for even more ease of use.

The line ends up on a removable halo spool, so spools of line with varying weights can be used on the same winder. The winder is built from standard hardware-store parts with common tools in a few hours. Because the line storage is not limited by the size of the winder, the mechanical advantage of a small capstan can be used to pull in a lot of line.

The conventional method of winding the line directly on a lightweight spool under high stress risks collapsing the destination reel due to the elastic band effect. The design shown here limits the tension on the takeup reel to the minimal amount needed to make sure the line will all get on the reel.

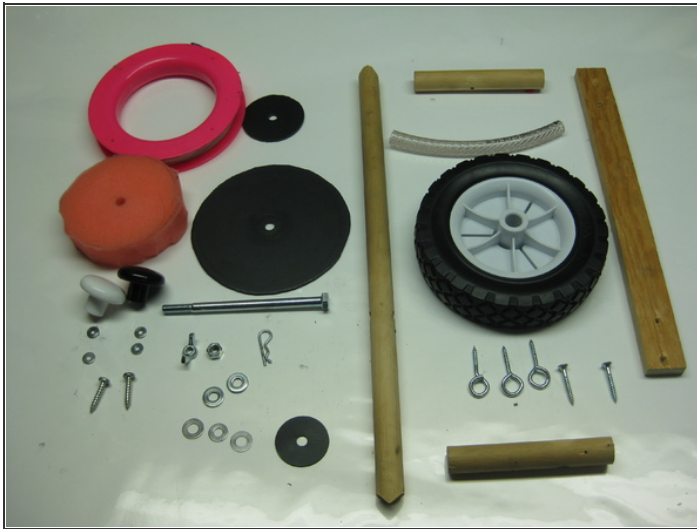
The robustness, strength, and small size of the reel/winch comes from the hub of a small lawnmower wheel as a capstan with a long 5/16" steel axle bolt mounted on a hefty wooden dowel. The widely available, lightweight halo reel is supported with soft, lightweight open-cell foam.

The dowel is fitted for one hand to hold braced against the cranker's waist while the other hand uses either the high power or high speed knobs on the crank handle.

The materials are chosen for easy construction in a decently equipped home workshop. The trickiest operation is cross-drilling the axle twice for a cotter pin and a hitch pin.

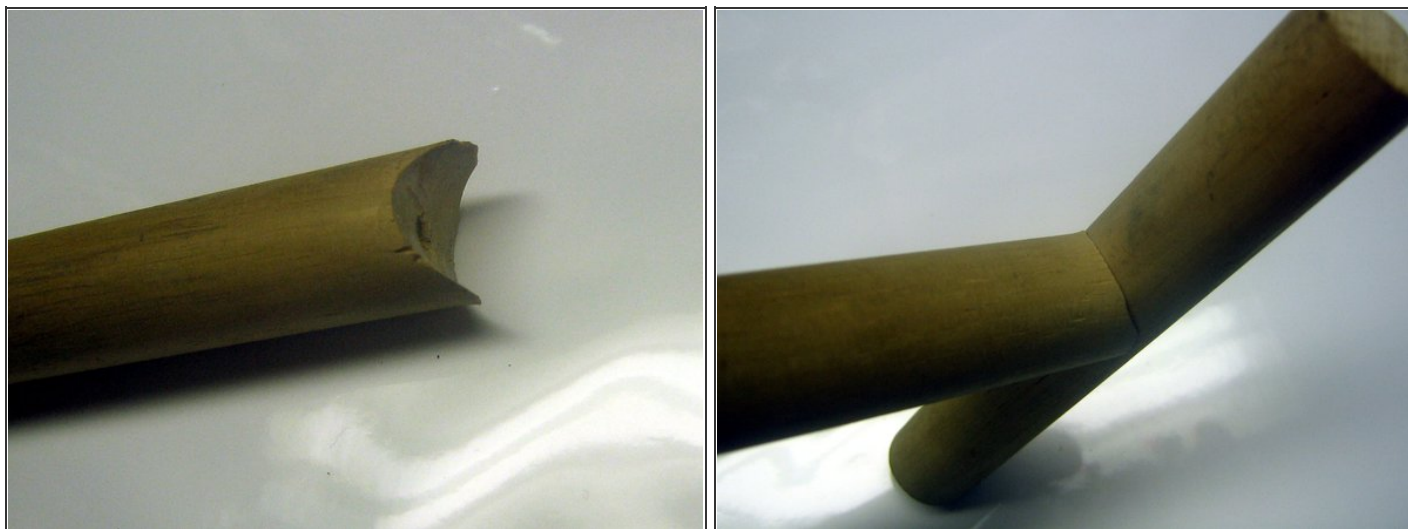
Some care is needed for threading the kite line on the winch—especially with a kite that is pulling strongly (use gloves)—but it is a straightforward operation once learned. Then launching and flying the kite to altitude is easily done with just the halo, and the winding down is done with the winch.

Step 1 — Parts needed



- See above for the detailed list.

Step 2 — Cut The wooden frame



- Cut the dowel into 3 pieces with the longest 3" longer than half your arm length and the two shortest about 8" long. The long piece is the spine of the winder, the short ones are the cross pieces.
- If you have a drill bit large enough, drill across the ends of the dowel to form mouths large enough to hold the short pieces neatly and rigidly at right angles to the long spine dowel. Try to orient the mouths so that the cross dowels are parallel with respect to each other.
- If you don't have such a large drill, cut the ends of the dowel into an open fishmouth shape of about 60 degrees at the base with your saw(s) and carve the end dowels to match.
- The fancy shapes at the ends of the spine are intended to hold the cross pieces from twisting and pulling the string out of alignment into a tangle.



Step 3



- Saw the tire off the lawnmower wheel.
- Press fit the hose into the axle hole. Watch for a taper and start from the wider end if there is one!
- Cross drill the hub of the wheel with the hose inside for the cotter pin. Drill from the outside of the flanges clear through the other side of the central bushing. This may take careful chucking in your drill since the bits are usually just long enough.
- If you do not have a drill of the right size try making one of your own. Clip a thick straightened wire to an angled point and use that. Coat hanger wire will work for soft plastic and wood.

Step 4 — Construct the Crank



- Cut the crank handle to 10". It should span the wheel hub and extend 3" extra on one side for the high-power knob.
- Drill holes for the high- and low-power knobs $\frac{3}{8}$ " from each end of the crank handle centered in its width. Drill a $\frac{5}{16}$ " hole for the axle bolt so the handle spans the hub; crossing both edges eliminates places where the string can catch.
- Assemble the knobs onto the crank arm. Make sure they spin freely and use washers either side of the aluminium arm to control wear and friction.
- The holes marked with red squares in the first image are for the knobs. The red circle marks the axle hole. The blue square in the last hole marks the hole for the locking bolt added later.



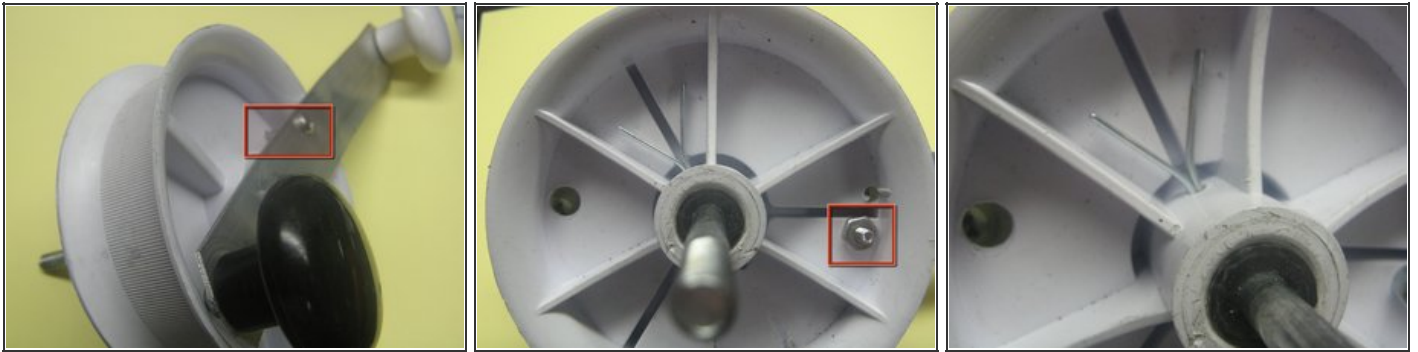
Step 5 — Prepare the hub and axle



- Ream out the hose bushing in the wheel hub to allow the 5/16" bolt to push through. This should be a snug fit but disassemble-able. Try using a 5/16" or slightly larger bit, make sure it is square to the wheel, make several passes to widen out the hole as much as possible in small increments.
- Press the axle bolt through the crank handle and the wheel hub. Mark the bolt for the cotter pin hole. Disassemble and center-punch the mark to guide the drill in the next step.
- Cross drill the bolt at the marked point with a bit big enough to hold one hitch pin. Be sure to:
 - use oil or wax to lubricate the drill bit;
 - hold the bolt in a vise or in vee blocks to keep it safely steady;
 - drill straight through the bolt starting at the punched dimple. Check and re-check your setup prior to drilling!



Step 6



- Drill through the crank and the hub close to the inside of the rim for the bolts to carry the cranking torque to the wheel hub. Use any web structures available to help carry the twisting forces.
- Use a nylock nut or a lock washers and a nut on to solidly fix the crank to the hub.
- Install the cotter pin to lock the capstan wheel to the axle.

Step 7 — Axle hole in spine



- Use your assembled crank and axle to pick the spot for the 5/16" axle hole on the spine. It must be closer to one end but far enough to leave the crank and your hand clear of the crosspiece and its hardware.
- (Sharp eyes may notice I have left off the locking bolt from the capstan to the crank in the first picture.)
- Cross drill a 5/16" hole for the axle bolt in the same plane as the top cross piece. Slightly out of line is O.K. but noticeable.
- Check the fit of the axle bolt in this hole. It should turn smoothly and easily without wobbling. Ream the hole out if needed by re-drilling it until the axle fits well.
- Lubricate the hole with some powdered graphite. Be sure to cover one end before puffing the graphite or you will have black graphite everywhere!

Step 8



- Find the place to drill for the hitch pin by assembling most of the axle components:
- First put the handle and then the hub on the axle (they will be loose for now),
- shove the capstan locking hitch pin through the bolt,
- add a washer and a shim washer on top,
- push the bolt through the hole in the spine dowel
- and add another pair of thick washers.
- Mark the place to drill for the hitch pin that will hold the axle on the spine. Leave a bit of room between where the hole will go and the second washer to account for the thickness of the pin. Take all the stuff off the bolt and cross drill it as for the first hitch pin.

Step 9 — Discs for the Reel Mount and Slipper Clutch



- Cut a Sintra disk at least 2 1/4" across and make the center hole 5/16" to fit loosely over the axle bolt. Hole saws work well for this since they drill a (small) centre hole for you.
- Cut a Sintra disk just larger than the inside of your largest reel with a centre hole for the axle. Trace your reel onto the plastic sheet and free hand cut outside that line. Mark the centre and drill the axle hole. Absolute circularity and concentricity is nice but not necessary.
- Smooth the edges of the discs so the kite line will not catch.
- Cut foam discs to hold your reels from the inside. They must be a snug interl fit and the 5/16" hole should be close to the centre of the mounted reel. Punching the holes with 5/16" tubing or rod against a hard surface works well.

Step 10



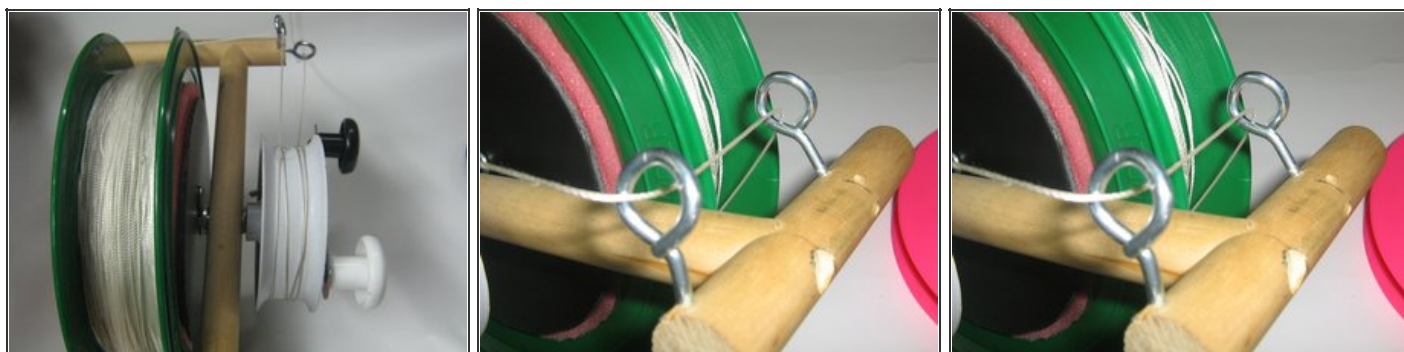
- Add the rubber washer outside the second hitch pin.
- Add the larger Sintra disk outside the washer
- Pop the A foam disk onto the axle, add the smaller thin disk, a washer and a hexagonal nut.
- Tighten the hex nut enough that the foam and discs rotate with the axle when cranking but the inside disc can be stopped with the pressure of a bare thumb.
- Twist on the wing nut until it solidly touches the hexagonal nut. The nuts will jam together to resist the tendency for the slipping reel clutch to loosen or tighten itself.

Step 11



- Twist the loops of the eye screw out of line so that a kite line can easily be slipped in diagonally but will not wander out if pulled at right angles to the loop. 1/16" is enough for most kite line up to 150 pound test.
- Drill a hole for the eye screw in the flat end of the dowel that will be the top crosspiece. Screw the loop in until it can barely be adjusted for alignment.
- Pre-drill and screw the lower dowel crosspiece onto the spine. This is a belly brace to help with holding the winch with one hand while the other cranks. This should be glued later after any fit adjustments.
- Pre-drill and screw the upper crosspiece so that the inside hole of the loop on the end is aligned with the outermost part of the flat spot on the wheel hub. Align the loop so that the twisted-out part is away from the wheel hub.
- Drill a hole for a second screw eye aligned with the innermost flat spot of the wheel hub. This fairlead should protrude upwards from the crosspiece
- The third screw eye will be aligned with the centerline of the halo reel, so fit it on the foam insert and drill the mounting hole.
- Twist in screw eyes with the loop oriented along the crosspiece. Alignments with the reel and hub can be adjusted by twisting as needed.

Step 12 — Threading the line on the winder



- Threading this machine is less complicated than threading a sewing machine, but it is as important to get it right.
- The line is threaded in from the bottom of the halo reel to the kite as follows:
 - It feeds up from the bottom of the reel
 - to the reel-side fair lead
 - to the capstan takeoff fair lead
 - around the capstan 4 times in the same direction as the takeoff reel
 - then through the capstan fair lead to the kite.

Step 13

- Using the thing.
- I have some demonstration video online of a previous generation unit.
 - [Video introduction](#) showing threading, winding, and unwinding.
 - [Assembly video](#) with a 3 year old 'assisting'

Step 14

- Tweaks and improvements
 - The position and angles of the fairleads is tweakable within a large range.
 - If the line falls out of a fairlead, stop winding! Correct the situation or you will have some wonder-full snarls that can rip line apart.
 - The crank arm lengths are tweakable. I chose lengths that will work with my 54" delta up to Beaufort 4 (30 km/h). The long arm is really important for that.
 - The spine length is probably the biggest affecter of comfort. Experience will show what lengths work best for you.
 - Some way to anchor the line while threading this monster seems needed. If there was a waist belt and a cleat on the top cross piece, threading under load would be a lot easier.
 - If inner portion of the capstan had a diameter larger than the take up reel on in line with the take off fairlead, then the reel breaking would be unnecessary when unwinding.
 - A locking loop to hold the crank from turning would allow hands free flying.
-

Putting the winder to use

Compared to a simple halo this winder is complex, and that may not be appropriate for a simple flying session. But, if you have to move a lot of line quickly under high tension, this unit will save a lot of effort and pain, especially if you can use the drill power option.

This document was last generated on 2013-01-07 04:13:58 PM.